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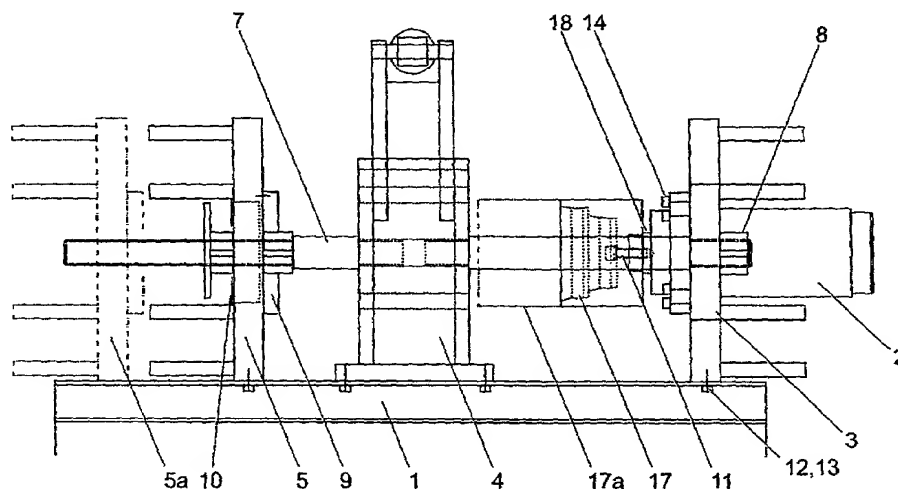
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[Continued on next page]

(54) Title: APPARATUS FOR SWAGING AN OBJECT



(57) Abstract: An apparatus for swaging an end of a tubular (22) is described as comprising a swaging head (17) for providing the swage to the end of the tubular (22). The swaging head (17) has two or more swaging formations (22A, 22B) provided thereon to permit swaging of differing diameters of tubular ends. The apparatus may comprise a stop plate (5, 9) for abutment against the other end of the tubular (22), where the swaging head (17) and the stop plate (5, 9) are movably coupled to one another. The apparatus may have a clamping device (4) for clamping the tubular (22), where the clamping device is split into at least three part-circular clamping segments (30) which clamp around the outer circumference of the tubular to permit it to be swaged. The clamping device (4) may have a plurality of teeth (35) for gripping the outer surface of the tubular (22), and a plurality of grooves (36) formed between the teeth (35). The gripping surface of each tooth (35) is substantially parallel to the longitudinal axis of the tubular (2) to be gripped.

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FORM PTO-1390 (REV. 10-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER M0378/7000
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (if known, see 37 CFR 1.5) <b>09/913370</b>
INTERNATIONAL APPLICATION NO. PCT/GB00/00430	INTERNATIONAL FILING DATE 11 February 2000 (11.02.00)	PRIORITY DATE CLAIMED 12 February 1999 (12.02.99)	
TITLE OF INVENTION APPARATUS FOR SWAGING AN OBJECT			
APPLICANT(S) FOR DO/EO/US WHYTE, Ronald; MUDGE, Joseph, Krist; MCLAUGHLIN, Thomas Kilpatrick			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).</li> <li>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the earliest claimed priority date (PCT Article 31).</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)).             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> has been transmitted by the International Bureau.</li> </ol> </li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(C)(5)).</li> </ol>			
<b>Items 11. To 16. Below concern document(s) or information included:</b>			
11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.			
12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.			
13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment			
14. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.			
15. <input type="checkbox"/> A substitute specification.			
16. <input type="checkbox"/> A change of power of attorney and/or address letter.			
17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.			
18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).			
19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).			
20. <input checked="" type="checkbox"/> Other items or information:			
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Copy of International Search Report			
Copy of PCT/IB/306 form			
Copy of International Preliminary Examination Report			
Express Mail Label No. EL819462491US			
Date Mailed: August 13, 2001			

U.S. APPLICATION NO. <b>09/913370</b>		INTERNATIONAL APPLICATION PCT/GB00/00430		ATTORNEY'S DOCKET NUMBER M0378/7000	
21. <input checked="" type="checkbox"/> The following fees are submitted: <b>BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee paid to USPTO (37 CFR 1.445(a)(2)), paid to USPTO \$710.00  International preliminary examination fee paid to USPTO (37 CFR 1.482) But all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00  International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 <b>ENTER APPROPRIATE BASIC FEE AMOUNT = 860.00</b>				<b>CALCULATIONS</b> PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$860.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	44-20 =	24	X \$18.00	\$432.00	
Independent Claims	4-3 =	1	X \$80.00	\$80.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+\$270.00	\$	
<b>TOTAL OF ABOVE CALCULATIONS</b>				=	\$1372.00
Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$	
<b>SUBTOTAL</b>				=	\$1372.00
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
<b>TOTAL NATIONAL FEE</b>				=	\$1372.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate coversheet (37 CFR 3.28, 3.31). \$40.00 per property				+	\$
<b>TOTAL FEES ENCLOSED</b>				=	\$1372.00
				Amount to be:	\$
				refunded	
				charged	\$
<p>a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>1372.00</u> To cover the above fees is enclosed.</p> <p>b. <input type="checkbox"/> Please charge my Deposit Account No. _____ In the amount of \$ _____ To cover the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23/2825. A duplicate of this sheet is enclosed.</p> <p>d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</p>					
<p><b>NOTE:</b> Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.</p>					
SEND ALL CORRESPONDENCE TO			SIGNATURE		
WOLF, GREENFIELD & SACKS, P.C. 600 Atlantic Avenue Boston, Massachusetts 02210 Tel: (617) 720-3500			Douglas R. Wolf		
			NAME		
			36,971		
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CUSTOMER NUMBER			23628		

Attorney's Docket No. M0378/7000 DRW  
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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: WHYTE, Ronald, et al.  
Serial No.: Not yet assigned  
Filing date: Herewith  
For: APPARATUS FOR SWAGING AN OBJECT  
Examiner: Not yet assigned  
Art Unit: Not yet assigned

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Box PCT  
Commissioner for Patents  
Washington, D.C. 20231

Sir:

**PRELIMINARY AMENDMENT**

Please amend the above-identified application, prior to Examination on the merits, to conform the specification with U.S. practice:

**In the Specification**

On page 1, before the first paragraph, please add the subheading:

-- Field of the Invention--.

On page 1, after the subheading "Field of the Invention," please insert the following section:

**Related Applications**

-- This application claims the benefit under 35 U.S.C. §120 or 35 U.S.C. §365(c) of PCT International application PCT/GB00/00430 designating the United States of America, and filed February 11, 2000.

Foreign priority benefits are claimed under 35 U.S.C. §119(a)-(d) or 35 U.S.C. §365(b) of Great Britain patent application number 9903150.2 filed February 12, 1999, which designated at least one country other than the United States.--.

On page 1, after the insertion of **Related Applications**, please insert the subheading:

--Background of the Invention--.

### **In the Claims**

Please rewrite claims 6, 7, 9, 10, 15, 16, 18, 19, 22, 23, 25, 27, 28, 32, 33, 36, and 39 as follows:

6. (Amended) An apparatus according to claim 4, wherein the surface of the internal bore of the swaging head provided by the taper from the first to the second diameter is a guiding surface, and the surface provided by the taper from the second to third diameter is a swaging surface.
7. (Amended) An apparatus according to claim 3, wherein the surface of the internal bore of the swaging head from the second/third diameter to the third/fourth diameter is arranged to be substantially perpendicular to the longitudinal axis of the swaging head.
9. (Amended) An apparatus according to claim 3, wherein the swaging head is arranged with at least first and second swaging formations, whereby the fourth diameter of the first swaging formation is greater than the first diameter of the second swaging formation.
10. (Amended) An apparatus according to claim 3, wherein the first diameter of the first swaging formation is the closest diameter of all of the diameters of all of the swaging formations to the tubular end, in use.
15. (Amended) An apparatus according to claim 13, wherein the surface of the external diameter of the swaging head provided by the taper from the first to the second diameter is a guiding surface, and the surface provided by the taper from the second to third diameter is a swaging surface.

16. (Amended) An apparatus according to claim 12, wherein the surface of the external diameter of the swaging head from the second/third diameter to the third/fourth diameter is arranged to be substantially perpendicular to the longitudinal axis of the swaging head.
18. (Amended) An apparatus according to claim 12, wherein the swaging head is arranged with at least first and second swaging formations, whereby the fourth diameter of the first swaging formation is smaller than the first diameter of the second swaging formation.
19. (Amended) An apparatus according to claim 12, wherein the first diameter of the first swaging formation is the closest diameter of all of the diameters of all of the swaging formations to the tubular end, in use.
22. (Amended) An apparatus according to claim 20, wherein the swaging head is moveable toward the stop plate by means of a piston.
23. (Amended) An apparatus according to claim 20, wherein the swaging head and the stop plate are movably coupled to one another by a frame.
25. (Amended) An apparatus according to claim 23, wherein the frame comprises at least one member coupled to both of the swaging head and the stop plate.
27. (Amended) An apparatus according to claim 25, wherein the coupling between the member and the stop plate comprises a screw thread engagement.
28. (Amended) An apparatus according to claim 20, wherein the stop plate comprises a bore and a device for obturating the bore, such that when the device obturates the bore, the device abuts the said other end of the tubular, in use.

Serial No.: Not yet assigned

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Art Unit: Not yet assigned

32. (Amended) An apparatus according to claim 30, wherein there are two clamping devices provided, a forward clamping device which is arranged to be closest to the swaging head, and a rear clamping device which is arranged to be furthest from the swaging head.

33. (Amended) An apparatus according to claim 30, wherein the clamping segments are housed within a clamping ring.

36. (Amended) An apparatus according to claim 33, wherein the clamping ring is split into at least two part circular members.

39. (Amended) An apparatus according to claim 33, wherein a range of segments can be housed within the ring.

Serial No.: Not yet assigned

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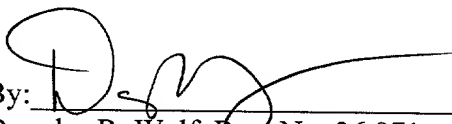
Art Unit: Not yet assigned

**REMARKS**

Applicant has amended the specification to provide priority application information under PCT Article 21(2) of the PCT application of which the above-identified application is a U.S. national stage application. No new matter has been added.

The claims have been amended to conform with U.S. practice. Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned **"MARKED-UP CLAIMS."**

Respectfully submitted,

By:   
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Attorney's Docket No.: M0378/7000 DRW  
Date: August 13, 2001



**MARKED-UP CLAIMS**

Claims 6, 7, 9, 10, 15, 16, 18, 19, 22, 23, 25, 27, 28, 32, 33, 36, and 39 have been amended as follows:

6. (Amended) An apparatus according to [either of claims] claim 4 [or 5], wherein the surface of the internal bore of the swaging head provided by the taper from the first to the second diameter is a guiding surface, and the surface provided by the taper from the second to third diameter is a swaging surface.
7. (Amended) An apparatus according to [any of claims] claim 3 [to 6], wherein the surface of the internal bore of the swaging head from the second/third diameter to the third/fourth diameter is arranged to be substantially perpendicular to the longitudinal axis of the swaging head.
9. (Amended) An apparatus according to [any of claims] claim 3 [to 8], wherein the swaging head is arranged with at least first and second swaging formations, whereby the fourth diameter of the first swaging formation is greater than the first diameter of the second swaging formation.
10. (Amended) An apparatus according to [any of claims] claim 3 [to 9], wherein the first diameter of the first swaging formation is the closest diameter of all of the diameters of all of the swaging formations to the tubular end, in use.
15. (Amended) An apparatus according to [either of claims] claim 13 [or 14], wherein the surface of the external diameter of the swaging head provided by the taper from the first to the second diameter is a guiding surface, and the surface provided by the taper from the second to third diameter is a swaging surface.
16. (Amended) An apparatus according to [any of claims] claim 12 [to 15], wherein the surface of the external diameter of the swaging head from the second/third diameter to the

third/fourth diameter is arranged to be substantially perpendicular to the longitudinal axis of the swaging head.

18. (Amended) An apparatus according to [any of claims] claim 12 [to 17], wherein the swaging head is arranged with at least first and second swaging formations, whereby the fourth diameter of the first swaging formation is smaller than the first diameter of the second swaging formation.

19. (Amended) An apparatus cording to [any of claims] claim 12 [to 18], wherein the first diameter of the first swaging formation is the closest diameter of all of the diameters of all of the swaging formations to the tubular end, in use.

22. (Amended) An apparatus according to [either of claims] claim 20 [or 21], wherein the swaging head is moveable toward the stop plate by means of a piston.

23. (Amended) An apparatus according to [any of claims] claim 20 [to 22], wherein the swaging head and the stop plate are movably coupled to one another by a frame.

25. (Amended) An apparatus according to [either of claims] claim 23 [or 24], wherein the frame comprises at least one member coupled to both of the swaging head and the stop plate.

27. (Amended) An apparatus according to [either of claims] claim 25 [or 26], wherein the coupling between the member and the stop plate comprises a screw thread engagement.

28. (Amended) An apparatus according to [any of claims] claim 20 [to 27], wherein the stop plate comprises a bore and a device for obturating the bore, such that when the device obturates the bore, the device abuts the said other end of the tubular, in use.

32. (Amended) An apparatus according to [either of claims] claim 30 [or 31], wherein there are two clamping devices provided, a forward clamping device which is arranged to be closest to

the swaging head, and a rear clamping device which is arranged to be furthest from the swaging head.

33. (Amended) An apparatus according to [any of claims] claim 30 [to 32], wherein the clamping segments are housed within a clamping ring.

36. (Amended) An apparatus according to [any of claims] claim 33 [to 35], wherein the clamping ring is split into at least two part circular members.

39. (Amended) An apparatus according to [any of claims] claim 33 [to 38], wherein a range of segments can be housed within the ring.

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518 Rec'd PCT/PTO 13 AUG 2001

1 "Apparatus for Swaging an Object"

2

3 The present invention relates to an apparatus for  
4 swaging an object, and particularly relates to an  
5 apparatus for swaging an end of a tubular member, such  
6 as a length of casing or drillpipe used in the oil and  
7 gas industry.

8

9 Conventionally, casing tubulars have a standard pin  
10 type connector at each end, and one end of a casing  
11 tubular is connected to an end of another casing  
12 tubular by means of a casing joint, commonly known as a  
13 coupler, and which comprises a short length of tube  
14 having a standard box type connector at each end.  
15 Alternatively, tubulars, such as drill pipe in  
16 particular, have a standard pin type connection at one  
17 end and a standard box type connection at the other  
18 end.

19

20 It is important that a made up tubular string, such as  
21 a casing, lining or drill string has a substantially  
22 linear throughbore at the joints between the respective  
23 tubulars, and couplers if present.

24

25 The pin and/or box connections are conventionally made

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1 up on a tubular by first swaging respectively inwardly  
2 or outwardly the outer diameter of the ends of the pipe  
3 by a suitable amount so that pins can be formed. This  
4 swaging of the outer diameter of the pipe necessarily  
5 respectively reduces or increases the internal diameter  
6 of the pipe end.

7  
8 After the end of the pipe has been swaged, the internal  
9 or external diameter of the end of the pipe is then  
10 machined. The swaging process ensures that there is  
11 material around the entire circumference of the  
12 internal or external diameter of the pipe that can be  
13 machined away, thereby achieving concentricity of the  
14 internal or external diameter of the pipe end.  
15 Additionally, this ensures that there are no thick or  
16 thin sections of wall thickness on the pipe end,  
17 thereby ensuring a constant wall thickness to the pipe  
18 end.

19  
20 Thereafter, the screw thread of the pipe end can be  
21 formed on its outer or inner circumference.

22  
23 A conventional machine for swaging an end of a pipe  
24 comprises a swaging head having a single swaging  
25 formation thereon for swaging a particular diameter of  
26 pipe. The pipe to be swaged is held between a semi-  
27 circular lower clamp and two upper quarter circular  
28 segments, where the two upper segments are hinged to  
29 the lower semi-circular clamp to permit the pipe to be  
30 inserted into the clamp. The clamp is provided with  
31 plurality of teeth, in a saw tooth arrangement, to grip  
32 the pipe. However, with the saw tooth arrangement, the  
33 teeth tend to bite into and damage the outer wall of  
34 the pipe. Furthermore, where the pipe has slight  
35 variations in the outer circumference of its wall, the  
36 teeth will tend to grip certain parts of the outer

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3

1 diameter more forcefully than other parts, since the  
2 clamping device is substantially immoveable once it has  
3 been closed.

4  
5 According to a first aspect of the present invention,  
6 there is provided an apparatus for swaging an end of a  
7 tubular, the apparatus comprising a swaging head for  
8 providing the swage to the end of the tubular, wherein  
9 the swaging head has two or more swaging formations  
10 provided thereon to permit swaging of differing  
11 diameters of tubular ends.

12  
13 The swaging formation may be provided on an internal  
14 bore of the swaging head, such that the internal bore  
15 of the swaging head engages the outer diameter of the  
16 tubular end to provide the swage thereto.

17  
18 Each swaging formation may comprise a first diameter of  
19 the swaging head, a second diameter being smaller than  
20 the first diameter, a third diameter being smaller than  
21 the second diameter, and a fourth diameter being  
22 smaller than the third diameter. Preferably, the  
23 internal bore of the swaging head tapers substantially  
24 linearly inwardly, with respect to the longitudinal  
25 axis of the swaging head, from the first diameter to  
26 the second diameter, and from the second diameter to  
27 the third diameter. Typically, the angle of the taper  
28 from the first to the second diameter is greater than  
29 the angle of the taper from the second to third  
30 diameter. Typically, the surface of the internal bore  
31 of the swaging head provided by the taper from the  
32 first to the second diameter is a guiding surface, and  
33 the surface provided by the taper from the second to  
34 third diameter is a swaging surface.

35  
36 The surface of the internal bore of the swaging head

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4

1 from the second/third diameter to the third/fourth  
2 diameter may be arranged to be substantially  
3 perpendicular to the longitudinal axis of the swaging  
4 head, and is preferably arranged to provide a shoulder  
5 or a stop surface against which the tubular end  
6 arrests.

7  
8 Preferably, the swaging head is arranged with at least  
9 first and second swaging formations, whereby the fourth  
10 diameter of the first swaging formation is greater than  
11 the first diameter of the second swaging formation.  
12 Typically, the first diameter of the first swaging  
13 formation is the closest diameter of all of the  
14 diameters of all of the swaging formations to the  
15 tubular end, in use.

16  
17 Alternatively, the swaging formation may be provided on  
18 an external diameter of the swaging head, such that the  
19 external diameter of the swaging head engages the inner  
20 diameter of the tubular end to provide the swage  
21 thereto.

22  
23 Each swaging formation may comprise a first diameter of  
24 the swaging head, a second diameter being greater than  
25 the first diameter, a third diameter being greater than  
26 the second diameter, and a fourth diameter being  
27 greater than the third diameter. Preferably, the  
28 external diameter of the swaging head tapers  
29 substantially linearly outwardly, with respect to the  
30 longitudinal axis of the swaging head, from the first  
31 diameter to the second diameter, and from the second  
32 diameter to the third diameter. Typically, the angle  
33 of the taper from the first to the second diameter is  
34 greater than the angle of the taper from the second to  
35 third diameter. Typically, the surface of the external  
36 diameter of the swaging head provided by the taper from

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5

1 the first to the second diameter is a guiding surface,  
2 and the surface provided by the taper from the second  
3 to third diameter is a swaging surface.

4  
5 The surface of the external diameter of the swaging  
6 head from the second/third diameter to the third/fourth  
7 diameter may be arranged to be substantially  
8 perpendicular to the longitudinal axis of the swaging  
9 head, and is preferably arranged to provide a shoulder  
10 or a stop surface against which the tubular end  
11 arrests.

12  
13 Preferably, the swaging head is arranged with at least  
14 first and second swaging formations, whereby the fourth  
15 diameter of the first swaging formation is smaller than  
16 the first diameter of the second swaging formation.  
17 Typically, the first diameter of the first swaging  
18 formation is the closest diameter of all of the  
19 diameters of all of the swaging formations to the  
20 tubular end, in use.

21  
22 Two or more swaging formations may be provided.

23  
24 According to a second aspect of the present invention,  
25 there is provided an apparatus for swaging an end of a  
26 tubular, the apparatus comprising a swaging head for  
27 swaging the end of the tubular, and a stop plate for  
28 abutment against the other end of the tubular, the  
29 swaging head and the stop plate being movably coupled  
30 to one another.

31  
32 Movement of the swaging head and the stop plate toward  
33 one another typically facilitates swaging of the said  
34 one end of the tubular.

35  
36 Typically, the swaging head is moveable toward the stop



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6

1 plate by means of a piston, and preferably, the swaging  
2 head and the stop plate are movably coupled to one  
3 another by a frame. Typically, the frame is adjustable  
4 such that distance between the stop plate and the  
5 swaging head can be further varied by adjustment of the  
6 frame.

7  
8 Typically, the frame comprising at least one member  
9 coupled to both of the swaging head and the stop plate,  
10 and preferably the coupling between the member and at  
11 least one of the stop plate and swaging head can be  
12 adjusted in order to vary the length of the member  
13 between the swaging head and the stop plate.  
14 Preferably, the coupling between the member and the  
15 stop plate is in the form of a screw thread engagement.

16  
17 Preferably, the stop plate comprises a bore and a  
18 device for obturating the bore, such that when the  
19 device obturates the bore, the device abuts the said  
20 other end of the tubular. Typically, the device is  
21 removable from the stop plate such that a tubular to be  
22 swaged may be passed through the bore. This provides  
23 the invention with the advantage that the device can be  
24 inserted into or over the bore so that short lengths of  
25 tubular can be swaged, and the device can be removed  
26 from the stop plate so that longer lengths of tubular  
27 can be swaged.

28  
29 According to a third aspect of the present invention  
30 provides an apparatus for swaging an end of a tubular,  
31 the apparatus comprising a swaging head for swaging the  
32 end of the tubular, and a clamping device for clamping  
33 the tubular, the clamping device being split into at  
34 least three part-circular clamping segments which clamp  
35 substantially around the outer circumference of the  
36 tubular to permit it to be swaged.

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7

1 Preferably, there are at least four part-circular  
2 clamping segments which clamp substantially around the  
3 outer circumference of the tubular to permit it to be  
4 swaged.

5  
6 Preferably, there are two clamping devices provided,  
7 typically a forward clamping device which is arranged  
8 to be closest to the swaging head, and a rear clamping  
9 device which is arranged to be furthest from the  
10 swaging head.

11  
12 Typically, the clamping segments are housed within a  
13 clamping ring, and may be mounted on the clamping ring  
14 in an arrangement such that the segments can move,  
15 preferably only to a relatively small degree, with  
16 respect to the ring.

17  
18 Preferably, the clamping ring is split into at least  
19 two part circular members, where the members may be  
20 hinged together, such that the ring may be opened to  
21 permit a tubular to be inserted into the ring, and  
22 closed to clamp the segments around the tubular.

23  
24 Typically, a range of segments can be housed within the  
25 ring, where the range of segments may be of varying  
26 radial thickness, to permit a range of differing  
27 diameter tubulars to be clamped.

28  
29 According to a fourth aspect, the present invention  
30 provides an apparatus for swaging a tubular, the  
31 apparatus comprising a swaging head for swaging the end  
32 of the tubular, and a clamping device for clamping the  
33 tubular, the clamping device having a plurality of  
34 teeth for gripping the outer surface of the tubular,  
35 and a plurality of grooves formed between the teeth,  
36 wherein the gripping surface of each tooth is

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8

1 substantially parallel to the longitudinal axis of the  
2 tubular to be gripped.

3

4 This provides the invention with the advantage that the  
5 teeth do not bite into the outer surface of the  
6 tubular, thus avoiding damaging the tubular.

7

8 The grooves may be formed with two side walls which are  
9 substantially perpendicular to the longitudinal axis of  
10 the tubular to be gripped, and may be formed with a  
11 lowermost surface which is substantially parallel to  
12 the longitudinal axis of the tubular to be gripped.

13

14 An embodiment of the present invention will now be  
15 described, by way of example only, with reference to  
16 the accompanying drawings, in which:-

17

18 Fig. 1 is a side view of an apparatus for swaging  
19 an end of a tubular in accordance with the present  
20 invention;

21 Fig. 2 is a plan view of the apparatus of Fig. 1;

22 Fig. 3 is an end view of the apparatus of Fig. 1;

23 Fig. 4 is an end view of the clamping device of  
24 the apparatus of Fig. 1;

25 Fig. 5 is a plan view of the clamping device of  
26 Fig. 4;

27 Fig. 6 is a cross-sectional view of a first  
28 swaging head for use of the apparatus of Fig. 1;

29 Fig. 7 is a second swaging head for use with the  
30 apparatus of Fig. 1;

31 Fig. 8 is a third swaging head for use with the  
32 apparatus of Fig. 1;

33 Fig. 9 is a fourth swaging head for use with the  
34 apparatus of Fig. 1;

35 Fig. 10 is a series of part cross-sectional side  
36 views of gripping devices for use with the

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9

1 clamping device of Fig. 4;  
2 Fig. 11 is an end view of one of the sets of  
3 gripping devices of Fig. 10;  
4 Fig. 12 is a part cross-sectional side view of the  
5 set of gripping devices of Fig. 11;  
6 Fig. 13 is a detailed cross-sectional view of a  
7 portion of the gripping device of Fig. 12;  
8 Fig. 14 is a side view of a first male swaging  
9 head for use of the apparatus of Fig. 1;  
10 Fig. 15 is a second male swaging head for use with  
11 the apparatus of Fig. 1;  
12 Fig. 16 is a third male swaging head for use with  
13 the apparatus of Fig. 1; and  
14 Fig. 17 is a fourth male swaging head for use with  
15 the apparatus of Fig. 1.

16  
17 Fig. 1 shows an apparatus for swaging the end of a  
18 tubular or a pipe such as a length of casing or  
19 drillpipe used in the oil and gas industry.

20  
21 The apparatus comprises a base frame 1 which, in use of  
22 the apparatus, would typically lie on a workshop floor.  
23 A press head 3 is mounted on the base frame 1 by means  
24 of a cap screw 12 and taper washer 13, such that the  
25 press head 3 stands vertically upright from the  
26 horizontally arranged base frame 1. A swaging cylinder  
27 2 is mounted on the press head 3 by means of a  
28 plurality of cap screws 14, such that the longitudinal  
29 axis of the swaging cylinder 2 is arranged to be  
30 substantially horizontal. A piston rod 18 is located  
31 within the swaging cylinder 2, such that the piston rod  
32 18 lies on the longitudinal axis of the swaging  
33 cylinder 2. The furthest end of the piston rod 18 is  
34 typically coupled to a swaging or die head 17 by means  
35 of a cap screw 11, such that actuation of the swaging  
36 cylinder 2 moves the piston rod 18, and hence die head

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10

1 17 outwardly from the swaging cylinder 2, until the  
2 piston rod 18 has potentially travelled its maximum  
3 stroke or contact is made with the stop shoulder, which  
4 is indicated in Fig. 1 by the die heads 17 reaching its  
5 position which is shown in phantom 17A. As shown in  
6 Fig. 1, it is preferred that the maximum stroke of the  
7 piston rod 18, and hence die head 17, is twelve inches.

8  
9  
10 A clamping unit 4 is mounted on the base frame 1 at  
11 approximately the mid-point of the base frame 1, such  
12 that the clamping unit stands vertically upright with  
13 respect to the base frame 1. The clamping unit 4 will  
14 be described in more detail subsequently.

15  
16 An end stop 5 is movably mounted upon the base frame 1,  
17 such that the end stop 5 stands vertically upright with  
18 respect to the base frame 1.

19  
20 A first pair of struts or strengthening members in the  
21 form of tie rods 6 are provided between the press head  
22 3 and the clamping unit 4, and are arranged to lie on  
23 the plane of the longitudinal axis of the swaging  
24 cylinder 2, on either side of the die head 17. The tie  
25 rods 6 are secured to the press head 3 by means of nuts  
26 8, and are screw threaded to the clamping unit 4. A  
27 second pair of struts or strengthening members in the  
28 form of tie rods 7 act between the clamping unit 4 and  
29 the end stop 5, and are arranged to lie on the plane of  
30 the longitudinal axis of the swaging cylinder 2. The  
31 tie rods 7 are secured to the clamping unit 4 by means  
32 of screw threads, and are secured to the end stop 5 by  
33 means of a nut 19 on one side of the end stop 5, and a  
34 hand wheel nut 15 on the other side of the end stop 5.  
35 It should be noted that the majority of the outer  
36 surface of the tie rods 7 is provided with a screw

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11

1 thread formation thereon, such that an operator of the  
2 apparatus can rotate the hand wheel nut 15 to permit  
3 the end stop 5 to be moved along the tie rods 7 from  
4 the position of the end stop 5 shown in Fig. 1 to the  
5 position of the end stop 5A shown in phantom in Figs. 1  
6 and 2. Thus, the distance between the end stop 5 and  
7 the die head 17 can be varied.

8  
9 As shown in Fig. 2, the end stop 5 is provided with a  
10 bore 20, which can be obturated by placing a push plate  
11 9 on the end stop 5, and attaching the push plate 9 by  
12 means of a stud 13, nuts 16 and a retaining plate 21.

13  
14 Accordingly, the push plate 9 can be placed on the end  
15 stop 5, as shown in Figs. 1 and 2, and the end stop 5  
16 can be positioned so that the push plate 9 butts  
17 against an end of a relatively short length of pipe,  
18 such as a pup joint 22 used in the oil and gas  
19 industry. The middle of the pup joint 22 can be  
20 supported by the clamping unit 4, and the swaging  
21 cylinder 2 can be operated to move the die head 17  
22 toward the closest end of the pup joint 22 to it, such  
23 that the die head 17 swages the end of the pup joint  
24 22.

25  
26 As shown in Fig. 4, the clamping unit 4 comprises a  
27 clamp base 41, and a pair of clamp arms 42, 43 which  
28 are respectively hingedly coupled to the clamp base 41  
29 by means of pivot pins 44, washers 51 and split pins 52  
30 at the lowest ends of the respective clamp arms 42, 43.  
31 The upper ends of the clamp arms 42, 43 can be  
32 releasably coupled together by means of a cylinder 45  
33 which is attached to one of the clamp arms 43 by means  
34 of a trunnion bearing half 46 and a socket head cap  
35 screw 47. A trunnion pin 48 is mounted on the other  
36 clamp arm 42 by means of a washer 49 and split pin 50,

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12

1 and the trunnion pin 48 is engageable with the trunnion  
2 bearing half 46, such that operation of the cylinder 45  
3 pulls the clamp arms 42, 43 toward one another.  
4 However, it should be noted that the connection between  
5 the arms 42, 43 can be varied so as to make them  
6 interchangeable, for ease of production.

7  
8 Thus, the clamp arms 42A, 43A are moveable from their  
9 open position shown in phantom on Fig. 4 in which a  
10 pipe (not shown) can be inserted into the clamp unit 4,  
11 to a closed position 42, 43 in which the clamping arms  
12 42, 43 substantially surround a section of the outer  
13 circumference of the tubular.

14  
15 A first example of a "female" die head 17A is shown in  
16 Fig. 6, where this die head 17A is suitable for swaging  
17 two different pipe sizes, these being a relatively  
18 large pipe size of  $13\frac{3}{8}$  inches outer diameter, and a  
19 smaller pipe having an outer diameter of  $10\frac{3}{4}$  inch.  
20 However, it should be noted that the specific  
21 dimensions of the diehead can be varied for different  
22 swaging requirements.

23  
24 This example of the die head 17A has a first swaging  
25 formation, generally designated as 22A, and is formed  
26 on the internal bore of the die head 17A. This first  
27 swaging formation 22A has a first diameter 23A formed  
28 at the mouth of the internal bore of the die head 17A.  
29 A second diameter 24A is shown as being to the right of  
30 the first diameter 23A in Fig. 6, where the second  
31 diameter 24A is slightly smaller than the first  
32 diameter 23A (13.86 inches). The surface of the  
33 internal bore tapers linearly inwards from the first  
34 23A to the second 24A diameters at an angle of  $9^\circ$  to  
35 the longitudinal axis of the die head 17, and forms a  
36 lead-in surface 25A to guide the pipe end into the

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13

1 internal bore of the die head 17. A third diameter 26A  
2 is shown in Fig. 6 as being to the right of the second  
3 diameter 24A, where the third diameter 26A is smaller  
4 (13.24 inches) than the second diameter 24A. The  
5 surface of the internal bore tapers linearly inwardly  
6 from the second 24A to the third 26A diameters at an  
7 angle of 3° to the longitudinal axis of the die head  
8 17, where the surface between the second 24A and third  
9 26A diameters forms a swaging surface 27A to provide a  
10 swage to the 13<sup>3</sup>/<sub>8</sub> inch pipe end. A shoulder 28A  
11 projects radially inwardly at an angle perpendicular to  
12 the longitudinal axis of the die head 17 and provides a  
13 stop surface thereon to ensure that the die heads 17  
14 cannot "overswage" the pipe end.

15  
16 A second swaging formation 22B is also provided on the  
17 internal bore of the die heads 17, and is shown in Fig.  
18 6 as being to the right of the first swaging formation  
19 22A. The various diameters 23B, 24B, 26B of the second  
20 swaging formation 22B are all smaller than the  
21 respective diameters 23A, 24A, 26A of the first swaging  
22 formation 22A, and are of a size suitable for providing  
23 a swage to a 10<sup>3</sup>/<sub>8</sub> inch pipe.

24  
25 Fig. 7 shows a second example of a die head 17B, and  
26 which has a first swaging formation 22C, which is  
27 similar to the first swaging formation 22A of the die  
28 head 17A, and a similar second swaging formation 22D.  
29 The swaging formations 22C, 22D are sized to provide a  
30 swage to respective pipe sizes 9<sup>5</sup>/<sub>8</sub> inch and 7<sup>5</sup>/<sub>8</sub> inch.

31  
32 Fig. 8 shows a third example of the die head 17C, where  
33 this die head 17C has three swaging formations 22E,  
34 22F, 22G provided thereon to enable the die head 17C to  
35 provide a swage to three different pipe sizes, these  
36 being respectively 7 inch, 5<sup>1</sup>/<sub>2</sub> inch and 4<sup>1</sup>/<sub>2</sub> inch.



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14

1 Fig. 9 shows a fourth example of a die head 17D, also  
2 having three swaging formations 22H, 22I, 22J provided  
3 thereon to enable the die head 17D to provide a swage  
4 to three different pipe sizes, these being respectively  
5  $6\frac{5}{8}$  inch, 5 inch and 4 inch pipe diameters.

6  
7 An operator of the apparatus can choose the correct die  
8 head 17A, B, C, D as required by the diameter of the  
9 pipe, and can attach the correct die head 17A, B, C, D  
10 by means of the cap screw 11.

11  
12 It will also be appreciated by those skilled in the art  
13 that a die head having one or more swaging formations  
14 formed on it's outer circumference for providing a  
15 swage to the inner bore of an end of a tubular can also  
16 be provided for use with the apparatus, and such a  
17 range of "male" dieheads is shown in Figs. 14 to 17.  
18 The one or more swaging formations on the outer  
19 circumference are, in essence, mirror images of the  
20 swaging formations hereinbefore described in detail.

21  
22 Figs. 11 and 12 show one set of clamping segments or  
23 collets 30A, B, C, D where each clamping collet 30  
24 circumscribes an angle of preferably slightly less than  
25  $90^\circ$  of a circle. However, it should be noted that two  
26 sets of clamping collets 30, 32 are utilised in the  
27 apparatus, as will now be described. As shown in Fig.  
28 10, a forward set 30 of collets is mounted to the  
29 clamping unit 4, where this first set 30 is arranged to  
30 be closest to the die head 17, and a rear set 32 of  
31 clamping collets is also mounted to the clamping unit  
32 4. The two lower clamping collets 30B, 30C are mounted  
33 to the lower semi-circular bore of the clamp base 41,  
34 and one of the upper clamping collets 30A, 30B are  
35 mounted to the respective clamp arms 42, 43, where each  
36 clamping collet 30A, B, C, D is mounted to the clamping

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15

1 units by means of a fixing screw 33 which passes  
2 through a first aperture 34 in the respective clamping  
3 collet 30A, B, C, D. Thus, since there is only one  
4 fixing screw 33 per clamping collet, the clamping  
5 collets 30 can move slightly with respect to the  
6 clamping unit 4, and this provides the apparatus with  
7 the advantage that the clamping collets can move to  
8 compensate for slight irregularities in the outer  
9 circumference of the pipe to be swaged.

10

11 However, the two lower clamping collets 30B, 30C may be  
12 modified to be combined into one lower clamping collet  
13 (not shown) which would preferably circumscribe an  
14 angle of slightly less than 180° of a circle. This  
15 modified lower clamping collet is also preferably  
16 mounted on the clamping unit in a suitable arrangement  
17 such that it can move slightly with respect to the  
18 clamping unit 4.

19

20 The inner bore of the clamping collets 30 is provided  
21 with a clamping formation thereon, as shown in Fig. 13.  
22 The clamping formation comprises a plurality of flat  
23 teeth 35 which are of equal width. The upper surface  
24 of the flat teeth 35 are parallel with the longitudinal  
25 axis of the pipe to be swaged, and the flat teeth 35  
26 are spaced apart by substantially flat troughs 36,  
27 where the flat troughs 36 are of substantially equal  
28 length with the flat teeth 35. In the clamping collets  
29 30 shown in Fig. 13, there are six flat teeth 35 per  
30 inch along the internal surface of the clamping collets  
31 30. The presence of the flat troughs 36 provide the  
32 advantage that corrosion or contamination appearing on  
33 the outer surface of the pipe to be swaged can be  
34 squeezed off by the flat teeth 35 and located within  
35 the flat troughs 36, thus providing an enhanced  
36 clamping action upon the pipe to be swaged.

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16

1 Furthermore, the flat teeth 35 do not "bite" into the  
2 outer surface of the pipe to be swaged.

3  
4 As shown in Fig. 10, there are ten arrangements of sets  
5 of clamping collets for clamping ten different  
6 diameters of pipe, although there may be additional  
7 sets provided for non-standard diameter pipes. The  
8 first set, as shown in set (1), is for clamping around  
9 the largest casing diameter normally used, this being  
10 13.38 inches. Set (2) and set (3) are for clamping  
11 10.75 inches and 9.63 inches diameter pipes  
12 respectively, with clamping collets 56 and 57  
13 respectively. The clamping collets 57 of set (3) can  
14 be combined with different radius collet inserts 58A,  
15 B, C, D, E, F, G by means of fixing screws 59 to permit  
16 smaller diameter pipe sizes 7.62 inches, 7 inches, 6.62  
17 inches, 5.5 inches, 5 inches, 4.5 inches and 4 inches  
18 respectively to be clamped. Thus, by combining the  
19 collet inserts 58A-G with the clamping collets 57, the  
20 apparatus has the advantage of providing a flexible  
21 arrangement for clamping and thereafter swaging a  
22 variety of different diameter pipe sizes.

23  
24 As stated before, the push plate 9 can be located on  
25 the end stop 5 to permit short lengths of pipe such as  
26 pup joints 22 to be swaged; clamping unit 4 is not used  
27 in this case and the two lower clamping collets 30B,  
28 30C support the pup joint 22 at its mid point. For  
29 longer lengths of pipe, the push plate 9 is removed,  
30 and the pipe end to be swaged is passed through the  
31 bore 20 of the end stop 5, and the clamp arms 42, 43  
32 are closed around the outer diameter of the pipe.

33  
34 The die head 17 is typically pushed onto the end of the  
35 pipe to be swaged, with typically 350 tonnes of push  
36 being applied. With this amount of push being applied,

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17

1 a shoulder 60 is provided on the clamping collets 30,  
2 32, 56, 57, and a shoulder 62 is provided on the collet  
3 inserts 58A-G, to ensure that the respective screws 33,  
4 59 are not broken when the push is applied.

5

6 The hydraulic pressure requirements of the cylinder 2  
7 are thus very high, and for many pipes, the piston push  
8 provided by the cylinder 2, 45 will be too great.

9 Therefore, there is provided a safety control system,  
10 on both the clamp unit 4 to ensure that the pipe is not  
11 crushed, and also on the die head piston cylinder 2, to  
12 ensure that overpressure is not applied when swaging.

13 An unloading valve is included in the hydraulic fluid  
14 control circuit and is arranged to dump overpressure of  
15 hydraulic fluid back into the hydraulic fluid  
16 reservoir. The unloading valve is actuated by the  
17 electronic circuit. Before swaging a pipe, the  
18 operator of the apparatus looks up the characteristics  
19 of the pipe in a manual provided with the apparatus,  
20 where the characteristics are typically weight or wall  
21 thickness, the grade of metal used in the pipe, and the  
22 outside diameter of the pipe. The manual then informs  
23 the operator what the safe pressure or load that the  
24 operator can apply to both the clamp unit and the  
25 swaging cylinder 2. The operator then inputs this safe  
26 pressure or load into the electronic circuit which, if  
27 this safe pressure or load is exceeded, the electronic  
28 circuit then operates the unloading valve. Operation  
29 of the unloading valve however retains the intended  
30 safe working pressure or load. A visual indicator may  
31 be used in addition, or in the alternative to the  
32 electronic circuit, to indicate that the correct  
33 pressure has been achieved.

34

35 Modifications and improvements may be incorporated into  
36 the embodiment without departing from the scope of the

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18

1 invention.

2

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19

1    CLAIMS:-

2

3    1.    An apparatus for swaging an end of a tubular, the  
4    apparatus comprising a swaging head for providing the  
5    swage to the end of the tubular, wherein the swaging  
6    head has two or more swaging formations provided  
7    thereon to permit swaging of differing diameters of  
8    tubular ends.

9

10   2.    An apparatus according to claim 1, wherein the  
11   swaging formation is provided on an internal bore of  
12   the swaging head, such that the internal bore of the  
13   swaging head is capable of engaging the outer diameter  
14   of the tubular end to provide the swage thereto.

15

16   3.    An apparatus according to claim 2, wherein each  
17   swaging formation comprises a first diameter of the  
18   swaging head, a second diameter being smaller than the  
19   first diameter, a third diameter being smaller than the  
20   second diameter, and a fourth diameter being smaller  
21   than the third diameter.

22

23   4.    An apparatus according to claim 3, wherein the  
24   internal bore of the swaging head tapers substantially  
25   linearly inwardly, with respect to the longitudinal  
26   axis of the swaging head, from the first diameter to  
27   the second diameter, and from the second diameter to  
28   the third diameter.

29

30   5.    An apparatus according to claim 4, wherein the  
31   angle of the taper from the first to the second  
32   diameter is greater than the angle of the taper from  
33   the second to third diameter.

34

35   6.    An apparatus according to either of claims 4 or 5,  
36   wherein the surface of the internal bore of the swaging

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20

1 head provided by the taper from the first to the second  
2 diameter is a guiding surface, and the surface provided  
3 by the taper from the second to third diameter is a  
4 swaging surface.

5  
6 7. An apparatus according to any of claims 3 to 6,  
7 wherein the surface of the internal bore of the swaging  
8 head from the second/third diameter to the third/fourth  
9 diameter is arranged to be substantially perpendicular  
10 to the longitudinal axis of the swaging head.

11  
12 8. An apparatus according to claim 7, wherein the  
13 surface of the internal bore of the swaging head from  
14 the second/third diameter is arranged to provide a  
15 shoulder or a stop surface against which the tubular  
16 end arrests, in use.

17  
18 9. An apparatus according to any of claims 3 to 8,  
19 wherein the swaging head is arranged with at least  
20 first and second swaging formations, whereby the fourth  
21 diameter of the first swaging formation is greater than  
22 the first diameter of the second swaging formation.

23  
24 10. An apparatus according to any of claims 3 to 9,  
25 wherein the first diameter of the first swaging  
26 formation is the closest diameter of all of the  
27 diameters of all of the swaging formations to the  
28 tubular end, in use.

29  
30 11. An apparatus according to claim 1, wherein the  
31 swaging formation is provided on an external diameter  
32 of the swaging head, such that the external diameter of  
33 the swaging head engages the inner diameter of the  
34 tubular end to provide the swage thereto.

35  
36 12. An apparatus according to claim 11, wherein each

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21

1 swaging formation comprises a first diameter of the  
2 swaging head, a second diameter being greater than the  
3 first diameter, a third diameter being greater than the  
4 second diameter, and a fourth diameter being greater  
5 than the third diameter.

6  
7 13. An apparatus according to claim 12, wherein the  
8 external diameter of the swaging head tapers  
9 substantially linearly outwardly, with respect to the  
10 longitudinal axis of the swaging head, from the first  
11 diameter to the second diameter, and from the second  
12 diameter to the third diameter.

13  
14 14. An apparatus according to claim 13, wherein the  
15 angle of the taper from the first to the second  
16 diameter is greater than the angle of the taper from  
17 the second to third diameter.

18  
19 15. An apparatus according to either of claims 13 or  
20 14, wherein the surface of the external diameter of the  
21 swaging head provided by the taper from the first to  
22 the second diameter is a guiding surface, and the  
23 surface provided by the taper from the second to third  
24 diameter is a swaging surface.

25  
26 16. An apparatus according to any of claims 12 to 15,  
27 wherein the surface of the external diameter of the  
28 swaging head from the second/third diameter to the  
29 third/fourth diameter is arranged to be substantially  
30 perpendicular to the longitudinal axis of the swaging  
31 head.

32  
33 17. An apparatus according to claim 16, wherein the  
34 surface of the external diameter of the swaging head  
35 from the second/third diameter to the third/fourth  
36 diameter is arranged to provide a shoulder or a stop



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22

1 surface against which the tubular end arrests, in use.

2

3 18. An apparatus according to any of claims 12 to 17,  
4 wherein the swaging head is arranged with at least  
5 first and second swaging formations, whereby the fourth  
6 diameter of the first swaging formation is smaller than  
7 the first diameter of the second swaging formation.

8

9 19. An apparatus according to any of claims 12 to 18,  
10 wherein the first diameter of the first swaging  
11 formation is the closest diameter of all of the  
12 diameters of all of the swaging formations to the  
13 tubular end, in use.

14

15 20. An apparatus for swaging an end of a tubular, the  
16 apparatus comprising a swaging head for swaging the end  
17 of the tubular, and a stop plate for abutment against  
18 the other end of the tubular, the swaging head and the  
19 stop plate being movably coupled to one another.

20

21 21. An apparatus according to claim 20, wherein  
22 movement of the swaging head and the stop plate toward  
23 one another facilitates swaging of the said one end of  
24 the tubular.

25

26 22. An apparatus according to either of claims 20 or  
27 21, wherein the swaging head is moveable toward the  
28 stop plate by means of a piston.

29

30 23. An apparatus according to any of claims 20 to 22,  
31 wherein the swaging head and the stop plate are movably  
32 coupled to one another by a frame.

33

34 24. An apparatus according to claim 23, wherein the  
35 frame is adjustable such that the distance between the  
36 stop plate and the swaging head can be further varied

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23

1 by means of adjustment of the frame.

2

3 25. An apparatus according to either of claims 23 or  
4 24, wherein the frame comprises at least one member  
5 coupled to both of the swaging head and the stop plate.

6

7 26. An apparatus according to claim 25, wherein the  
8 coupling between the member and at least one of the  
9 stop plate and swaging head is capable of adjustment in  
10 order to vary the length of the member between the  
11 swaging head and the stop plate.

12

13 27. An apparatus according to either of claims 25 or  
14 26, wherein the coupling between the member and the  
15 stop plate comprises a screw thread engagement.

16

17 28. An apparatus according to any of claims 20 to 27,  
18 wherein the stop plate comprises a bore and a device  
19 for obturating the bore, such that when the device  
20 obturates the bore, the device abuts the said other end  
21 of the tubular, in use.

22

23 29. An apparatus according to claim 28, wherein the  
24 device is removable from the stop plate such that a  
25 tubular to be swaged may be passed through the bore of  
26 the stop plate.

27

28 30. An apparatus for swaging an end of a tubular, the  
29 apparatus comprising a swaging head for swaging the end  
30 of the tubular, and a clamping device for clamping the  
31 tubular, the clamping device being split into at least  
32 three part-circular clamping segments which clamp  
33 substantially around the outer circumference of a  
34 portion of the tubular to permit it to be swaged.

35

36 31. An apparatus according to claim 30, wherein there

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24

1 are at least four part-circular clamping segments which  
2 clamp substantially around the outer circumference of  
3 the tubular to permit it to be swaged.

4  
5 32. An apparatus according to either of claims 30 or  
6 31, wherein there are two clamping devices provided, a  
7 forward clamping device which is arranged to be closest  
8 to the swaging head, and a rear clamping device which  
9 is arranged to be furthest from the swaging head.

10  
11 33. An apparatus according to any of claims 30 to 32,  
12 wherein the clamping segments are housed within a  
13 clamping ring.

14  
15 34. An apparatus according to claim 33, wherein the  
16 clamping segments are mounted on the clamping ring in  
17 an arrangement such that the segments can move with  
18 respect to the ring.

19  
20 35. An apparatus according to claim 34, wherein the  
21 clamping segments can move only to a relatively small  
22 degree with respect to the ring.

23  
24 36. An apparatus according to any of claims 33 to 35,  
25 wherein the clamping ring is split into at least two  
26 part circular members.

27  
28 37. An apparatus according to claim 36, wherein the  
29 two part circular members are hinged together.

30  
31 38. An apparatus according to claim 37, wherein the  
32 two part circular members are hinged together such that  
33 the ring is capable of being opened to permit a tubular  
34 to be inserted into the ring, and closed to clamp the  
35 segments around the tubular.

36

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25

1 39. An apparatus according to any of claims 33 to 38,  
2 wherein a range of segments can be housed within the  
3 ring.

4  
5 40. An apparatus according to claim 39, wherein the  
6 range of segments is of varying radial thickness, to  
7 permit a range of differing diameter tubulars to be  
8 clamped.

9  
10 41. An apparatus for swaging a tubular, the apparatus  
11 comprising a swaging head for swaging the end of the  
12 tubular, and a clamping device for clamping the  
13 tubular, the clamping device having a plurality of  
14 teeth for gripping the outer surface of the tubular,  
15 and a plurality of grooves formed between the teeth,  
16 wherein the gripping surface of each tooth is  
17 substantially parallel to the longitudinal axis of the  
18 tubular to be gripped.

19  
20 42. An apparatus according to claim 41, wherein the  
21 grooves are formed with two side walls which are  
22 substantially perpendicular to the longitudinal axis of  
23 the tubular to be gripped.

24  
25 43. An apparatus according to claim 42, wherein the  
26 grooves are formed with a lowermost surface which is  
27 substantially parallel to the longitudinal axis of the  
28 tubular to be gripped.

29  
30 44. A clamping device for use with the apparatus of  
31 claim 41, the clamping device comprising a plurality of  
32 teeth for gripping the outer surface of a tubular, and  
33 a plurality of grooves formed between the teeth;  
34 wherein the gripping surface of each tooth is  
35 substantially parallel to the longitudinal axis of the  
36 tubular to be gripped.

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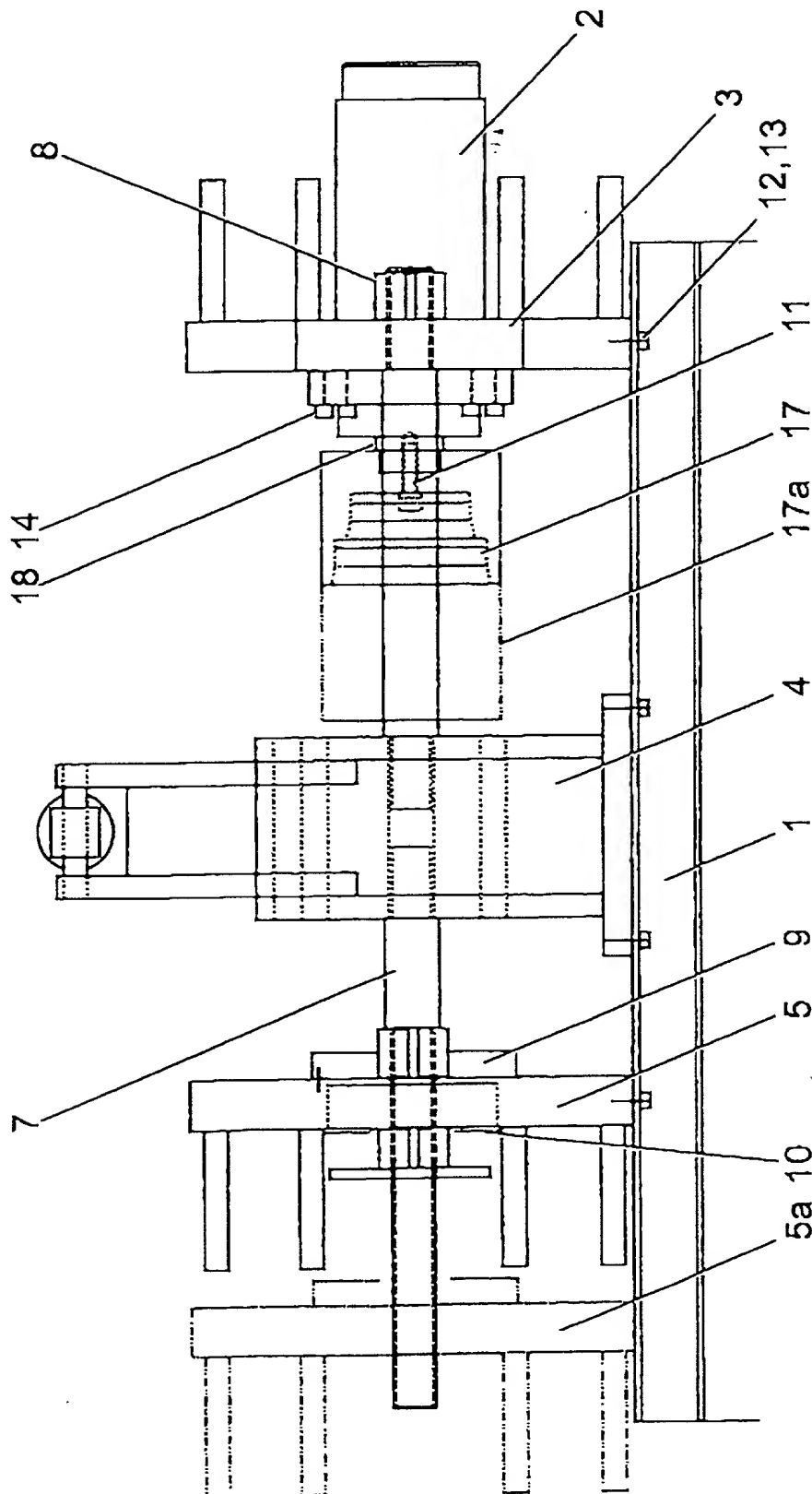


Fig. 1

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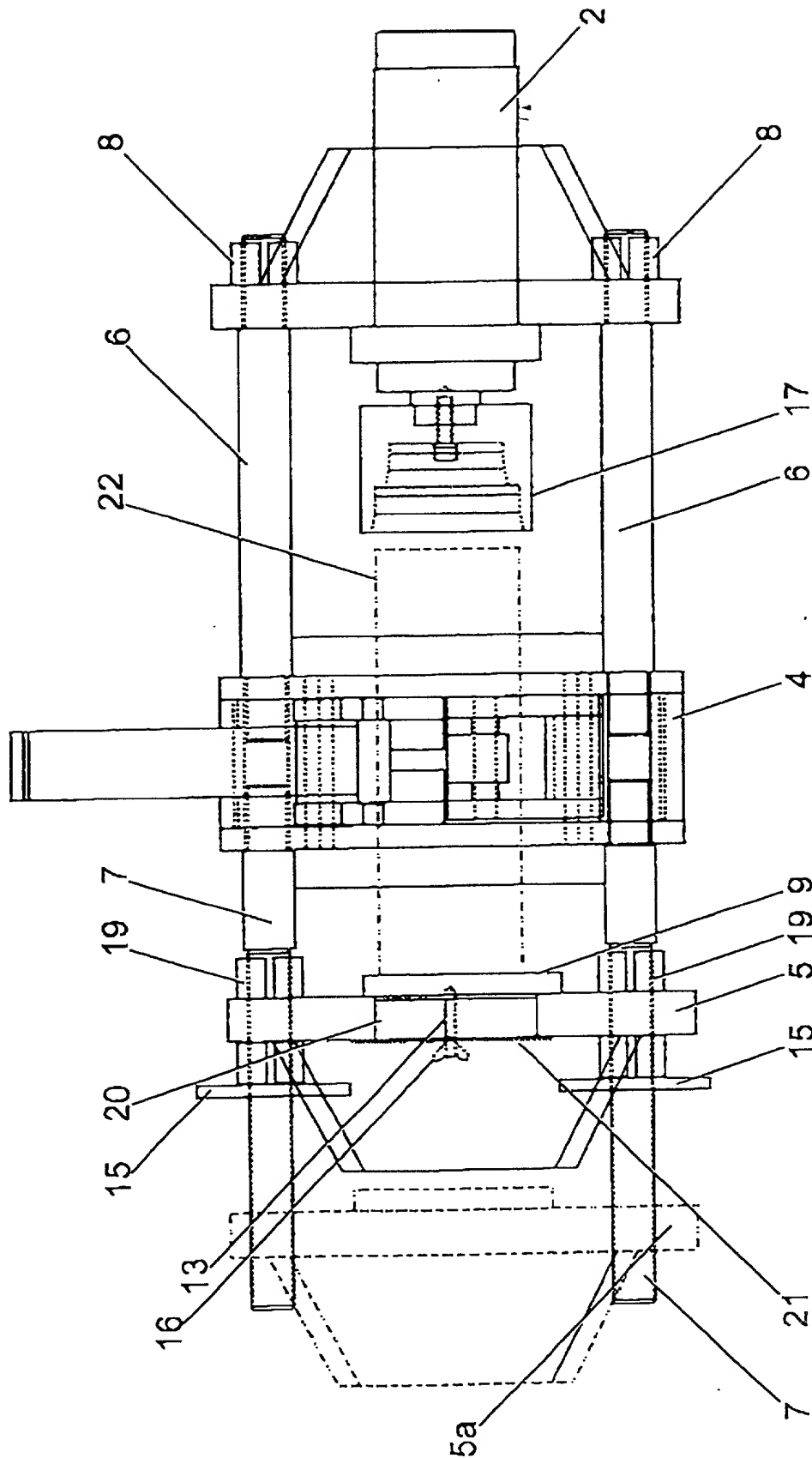
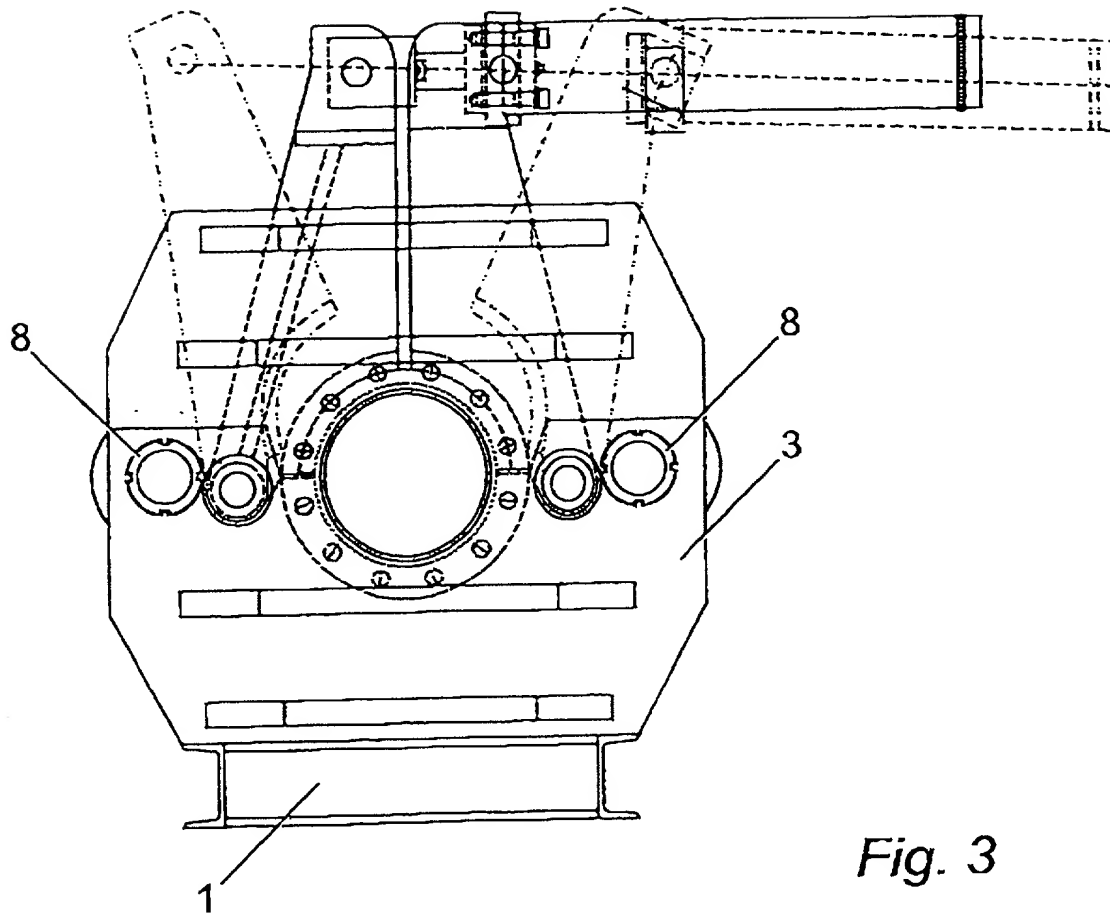


Fig. 2

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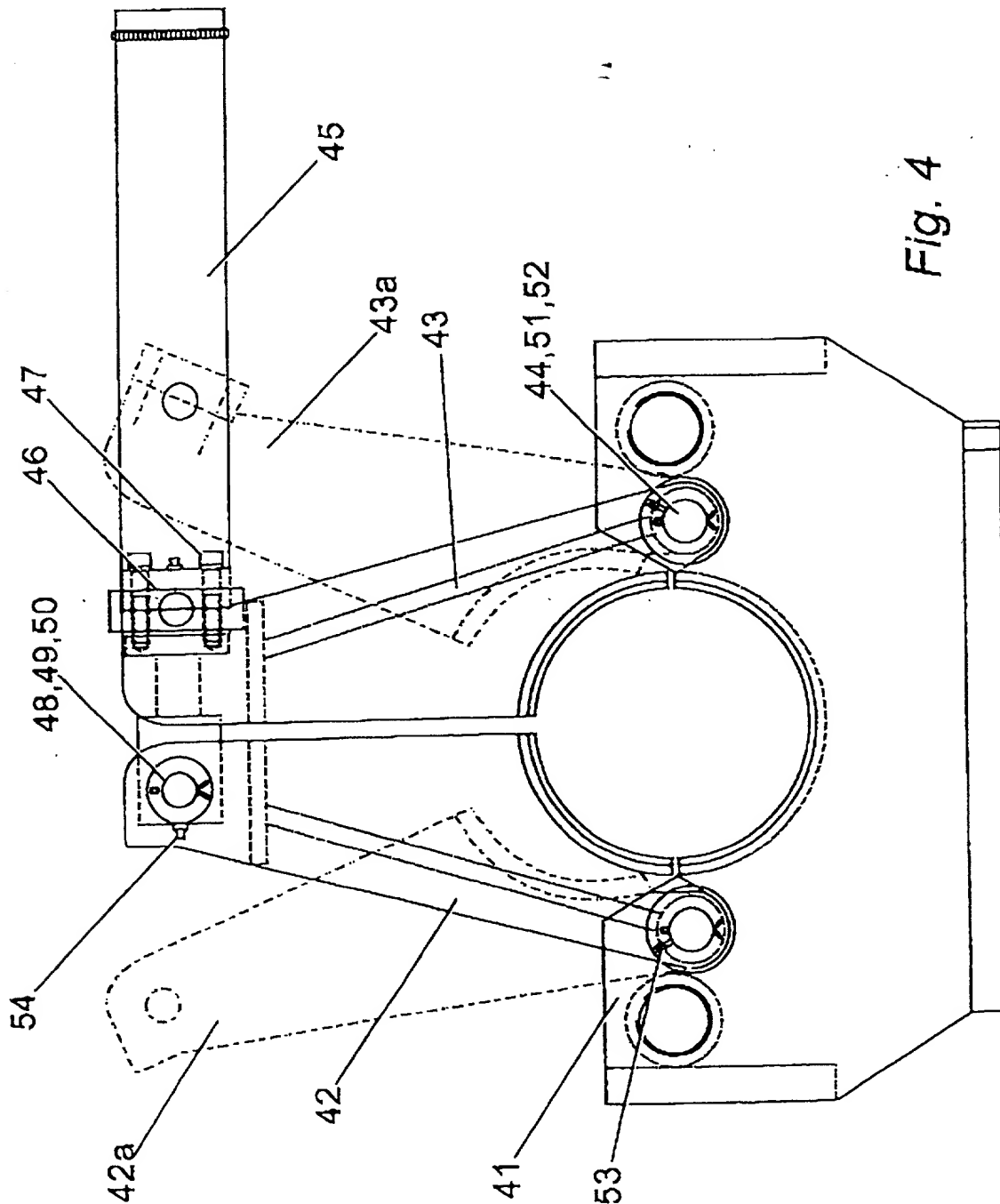


Fig. 4

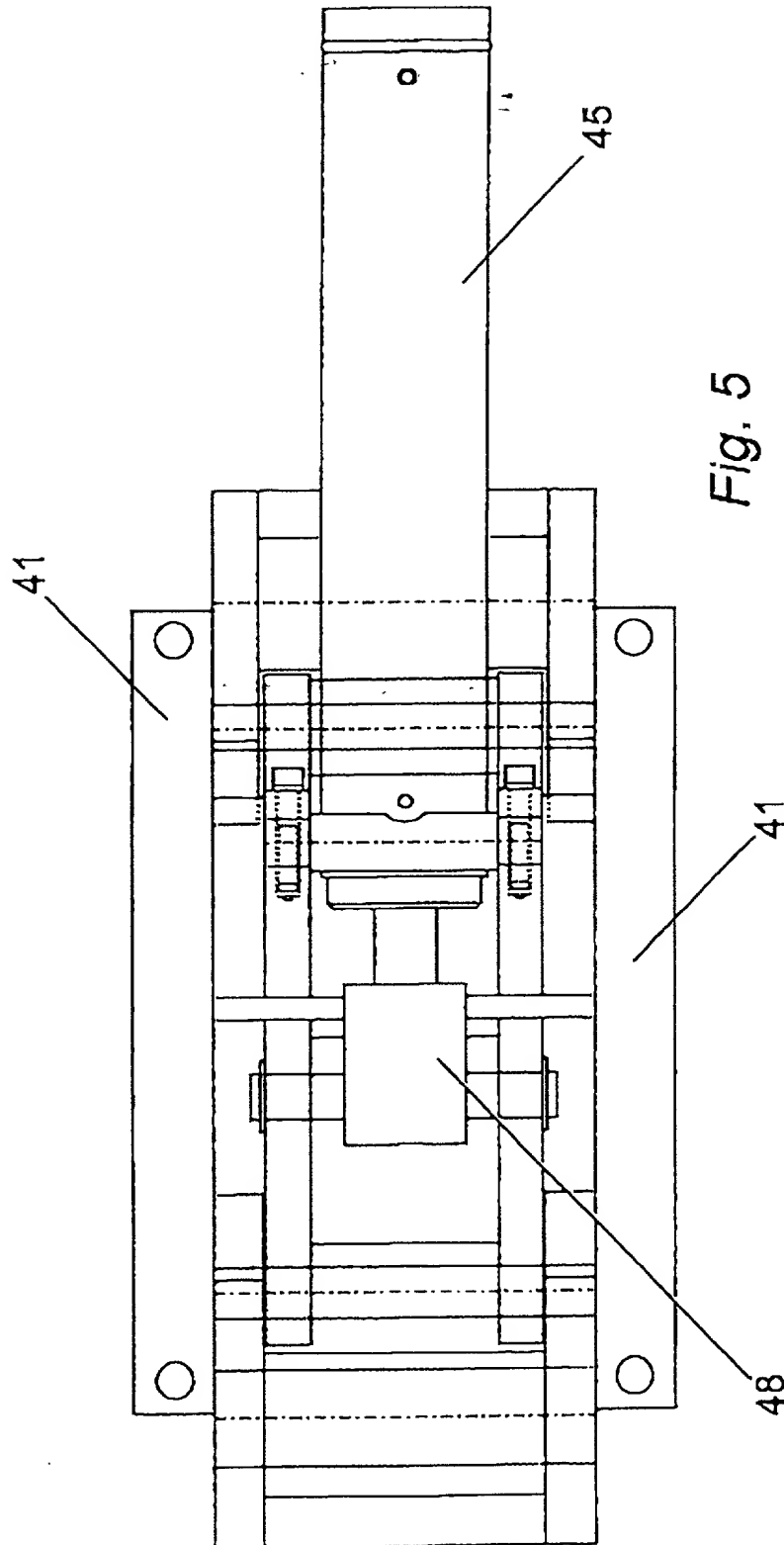


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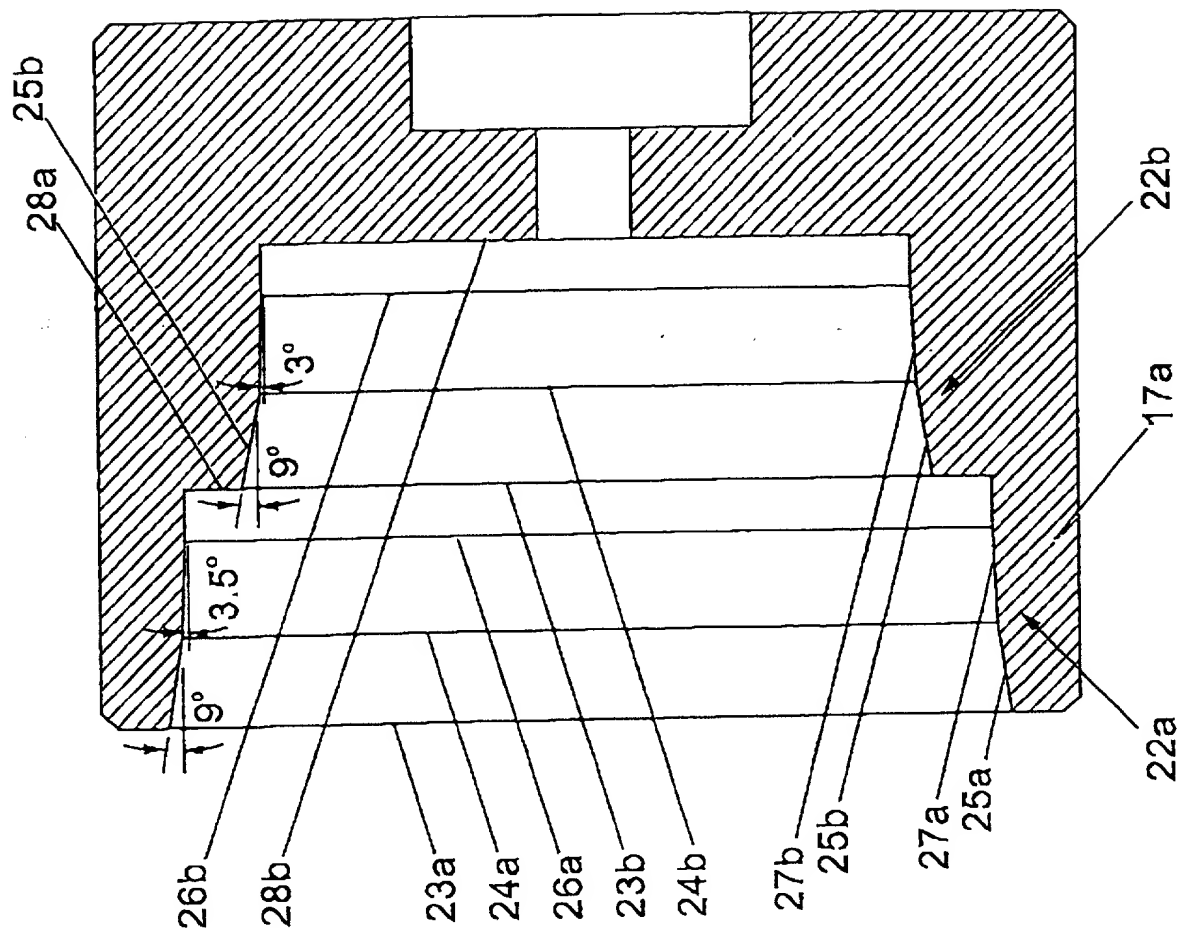
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Fig. 6



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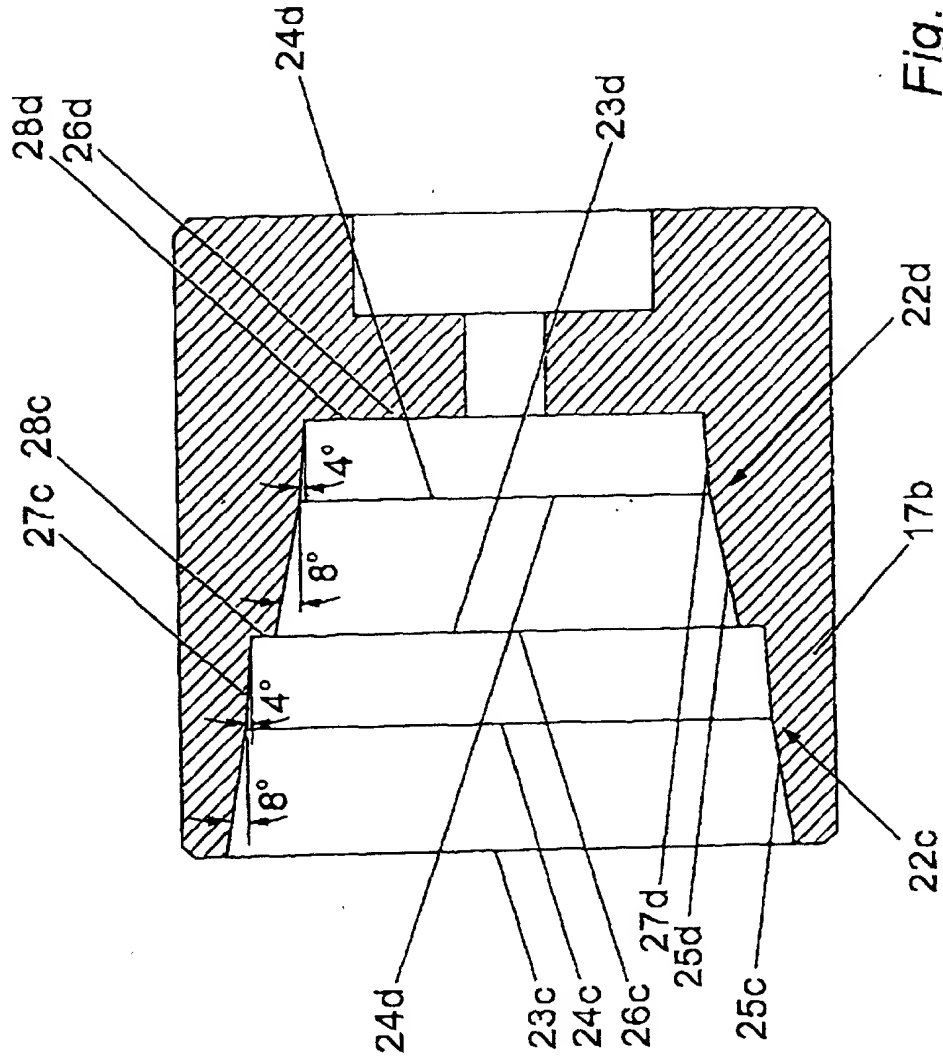


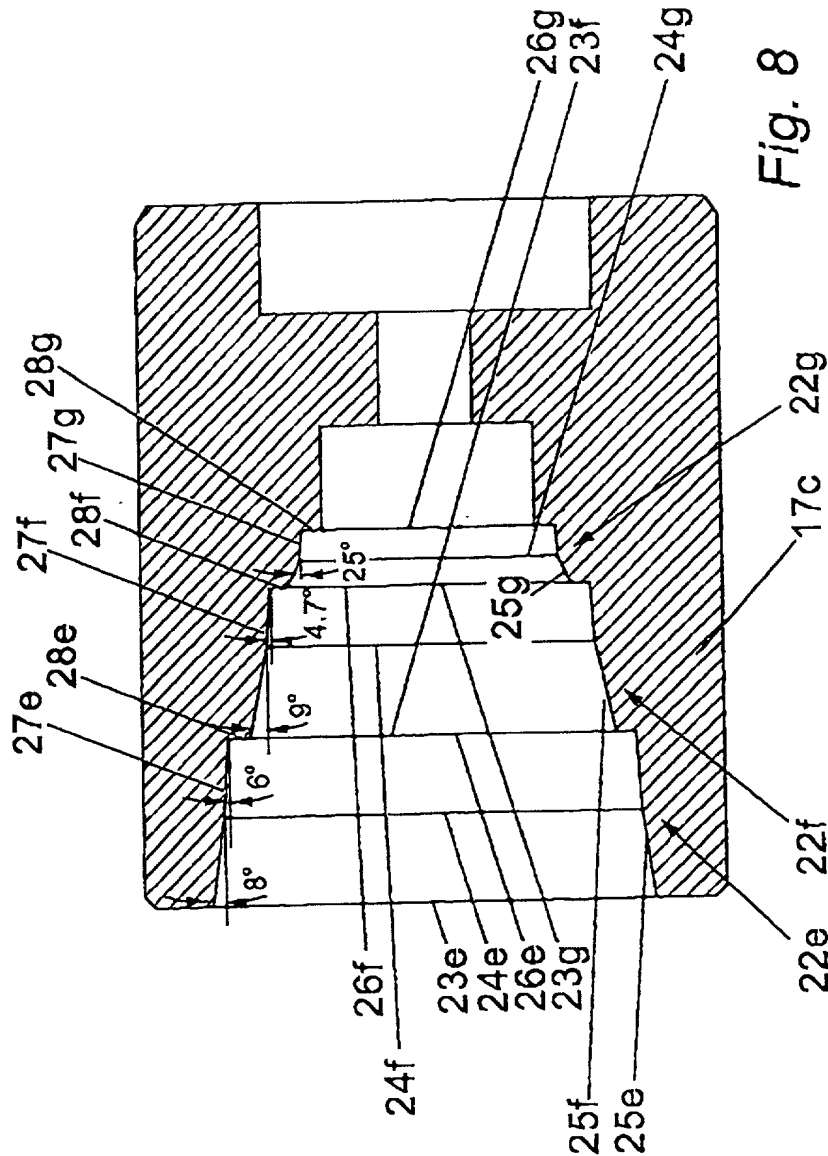
Fig. 7

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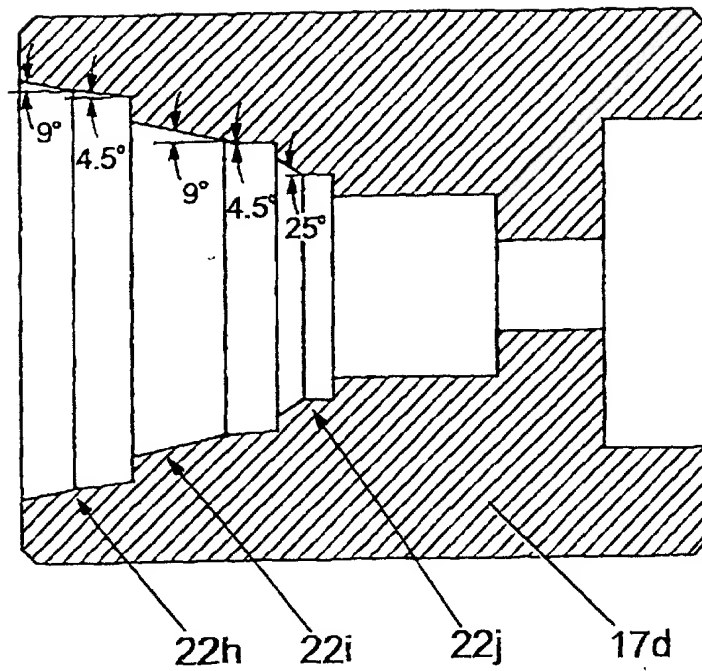


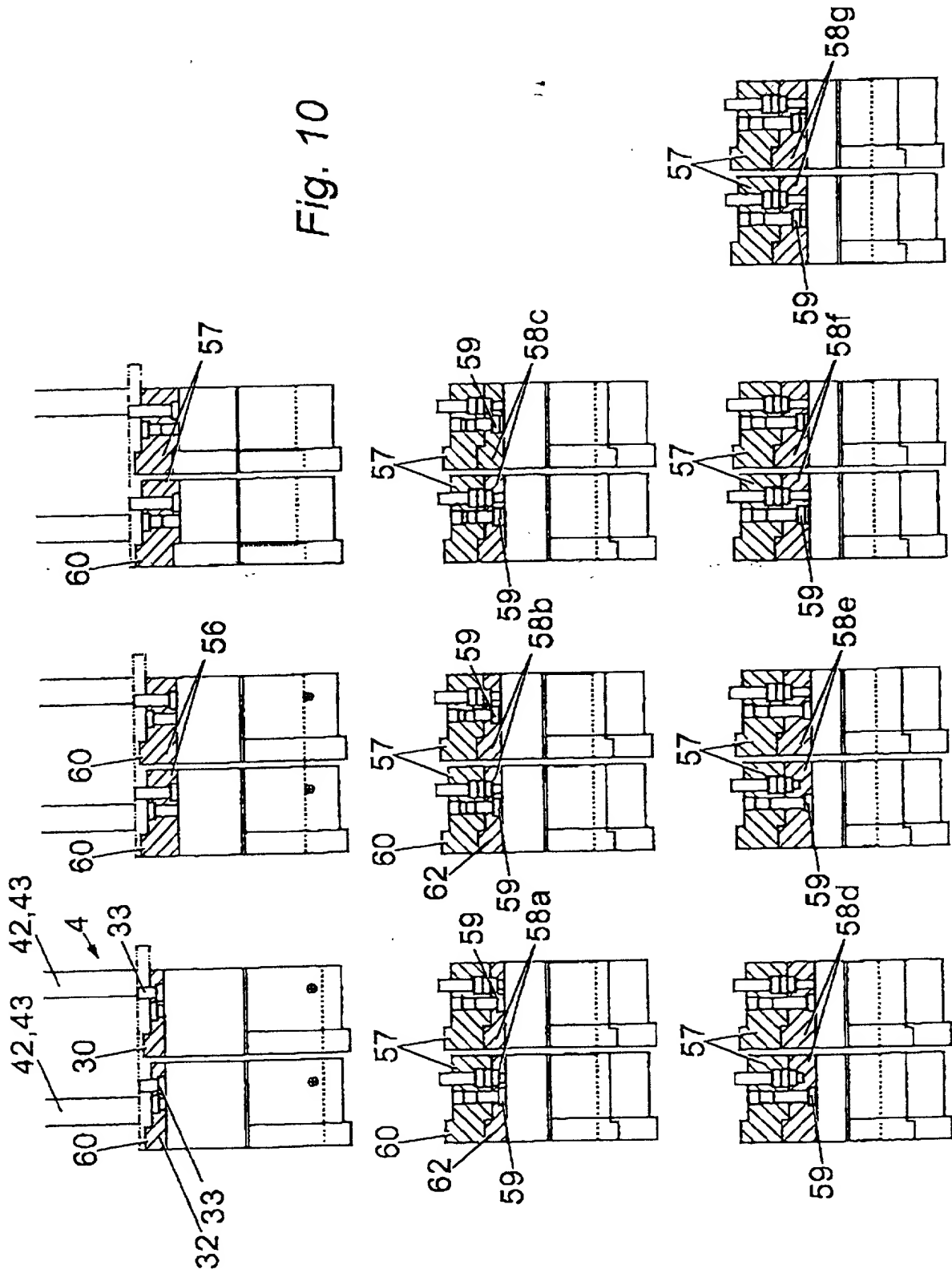
Fig. 9

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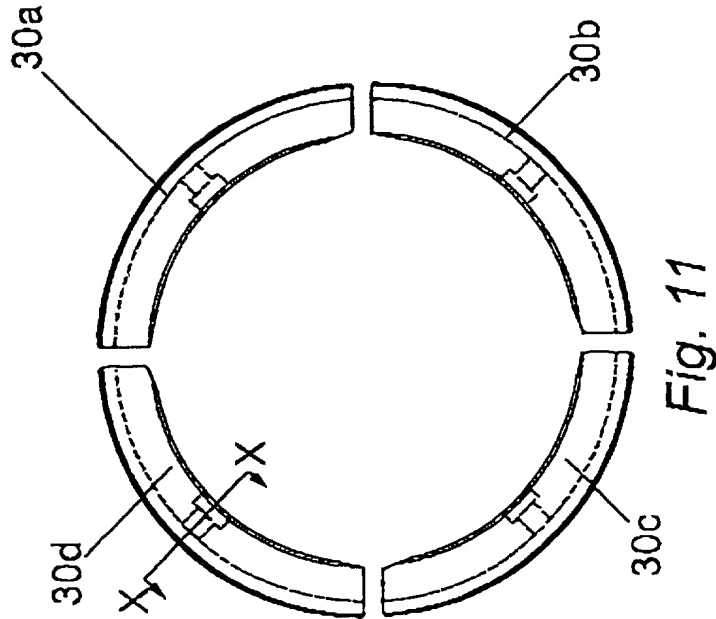
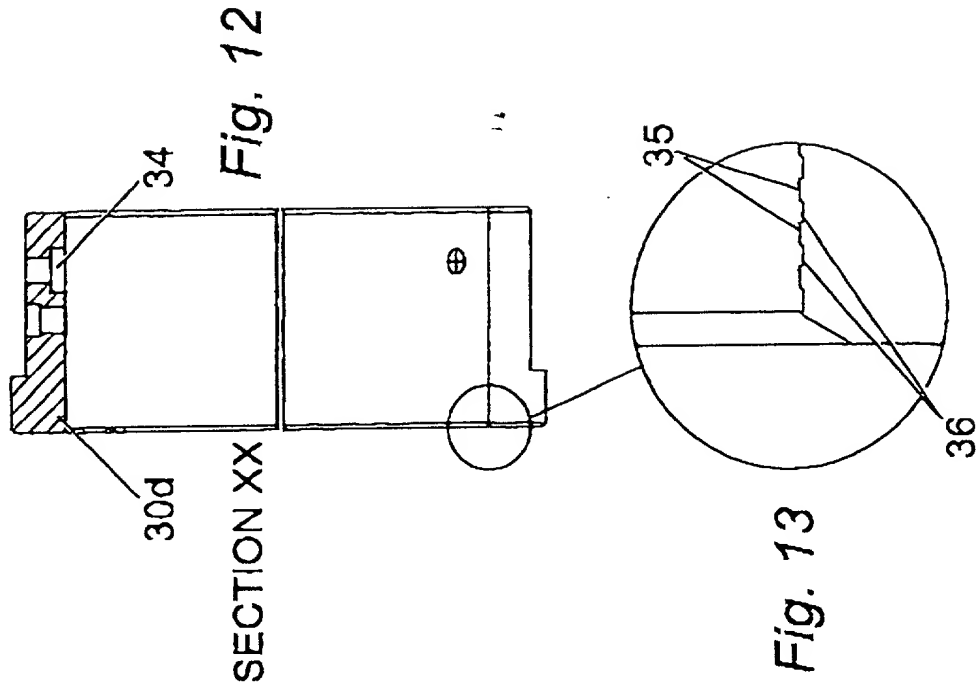
Fig. 10



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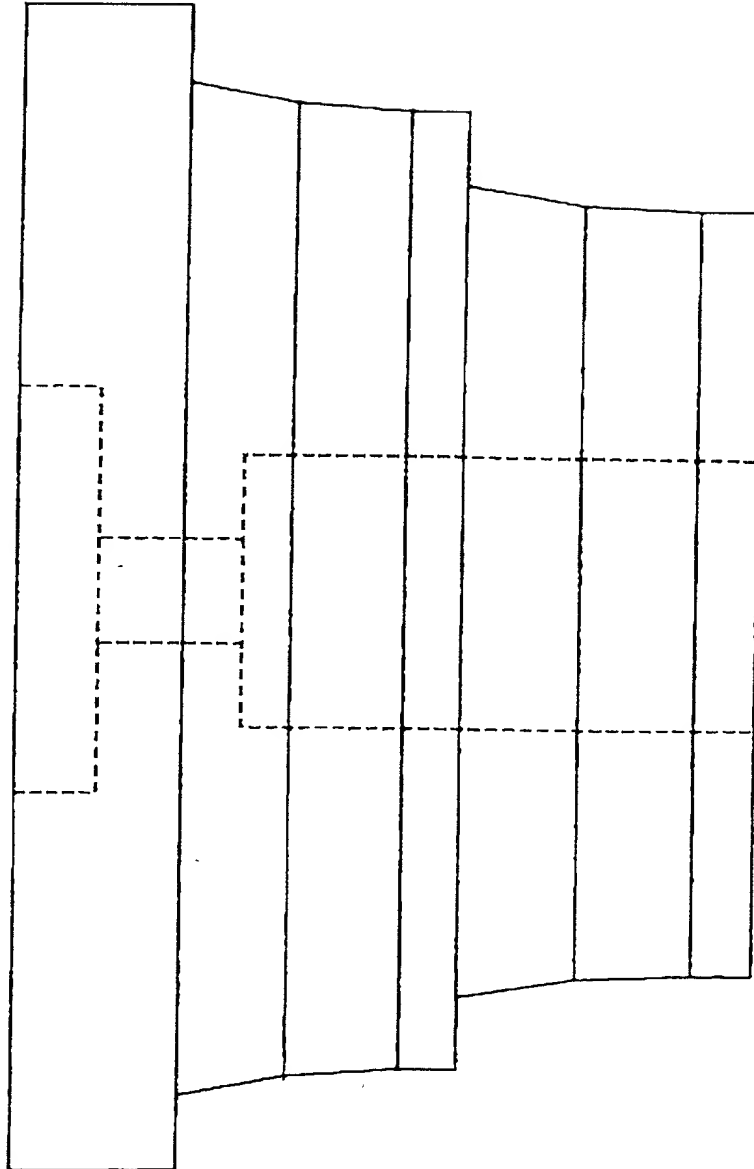


Fig. 14



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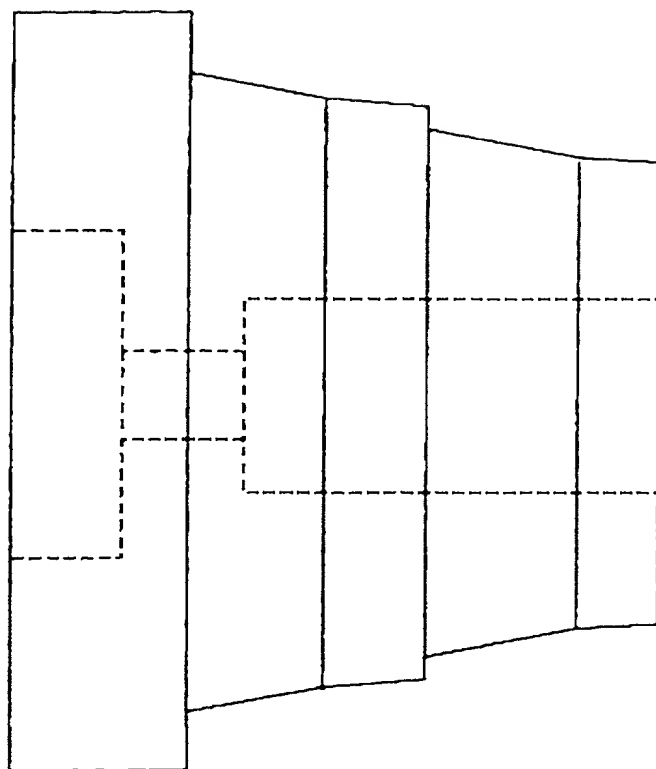


Fig. 15

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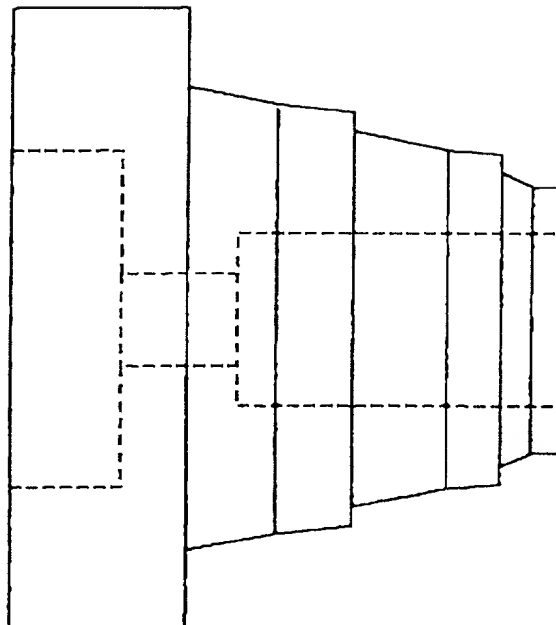


Fig. 16

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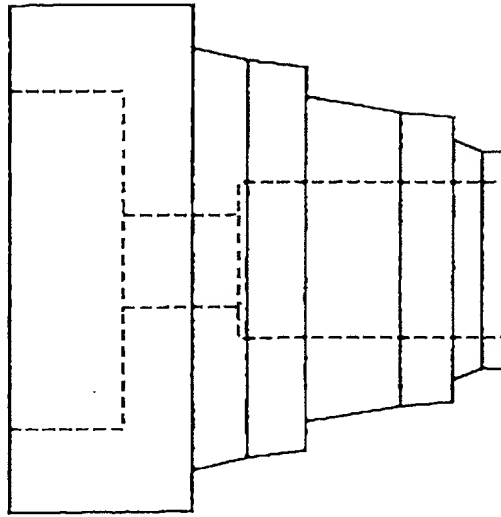
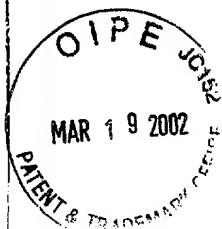


Fig. 17



Attorney Docket No. M0378/7000 DRW

**DECLARATION FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**APPARATUS FOR SWAGING AN OBJECT**

the specification of which was filed as PCT International Application No. PCT/GB00/00430, on February 11, 2000, which entered the U.S. on August 13, 2001, as U.S. Application Serial No. 09/913,370.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or section 365(a) of any PCT International application designating at least one country other than the United States listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign PCT International Application(s) and any priority claims under 35 U.S.C. §§119 and 365(a),(b):

Priority  
Claimed

9903150.2  
(Number)

GB  
(Country-if PCT, so indicate)

12/02/99  
(DD/MM/YY Filed)

[X] [ ]  
YES NO

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT International application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56

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which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application No.)	(filing date)	(status-patented, pending, abandoned)
PCT International Applications designating the United States:		
PCT/US00/00430	11.02.00	Pending
(PCT Appl. No.)	(U.S. Ser. No.)	(PCT filing date)
		(status-patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States

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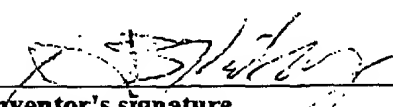
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X  \_\_\_\_\_  
Inventor's signature


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